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ABSTRACT

Over the past decade, undergraduate colleges and universities of all sizes, both public and private, throughout the United States, have begun to pursue reform for the sciences and mathematics. Evidence of this is illustrated by the almost 700 colleges and universities that are involved in Project Kaleidoscope (PKAL). Over the 1996-97 year, PKAL has been actively pursuing answers to questions related to the reform of undergraduate science education. This report gives an overview of that work. The report is a distillation of questions that successful reformers have asked, and PKAL has come up with key sets of questions that institutions successful in conceiving, implementing, and sustaining reform have addressed. The report addresses issues critical to successful science and mathematics reform. Sections include: (1) "Vision"; (2) "Agenda for Action"; (3) "Institutional Portfolio"; (4) "Natural Science Communities"; (5) "Resources"; (6) "Advocacy"; and (7) "The Question of Reform." (DKM)

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The Question of Reform

Report on Project Kaleidoscope
1996-1997

SE 060 537

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June 1997

Colleagues and Friends:

Where to begin in reporting on the work of Project Kaleidoscope over the past year? Just giving numbers doesn't quite tell the story, although we present on the following pages some statistics about involvement in PKAL activities in 1996 - 1997. Some reporting on the work of reform from the campuses would be interesting, but again, this would not afford the opportunity to present a coherent picture about what happens when colleges and universities begin to take reform seriously.

Taking reform seriously begins with asking the right questions, so we asked ourselves, *What are the questions, the patterns of analysis, evaluation and inquiry, that are being addressed by successful reformers?* Who must be involved at an institution in exploring these questions? Which questions must be asked first if curricular reform is to really work--if good ideas are to be implemented, if they are to reach all who can benefit from them, if they are to be sustained and make a difference?

Our report, therefore, is a distillation of what successful reformers have asked, and we've come up with the key sets of questions that institutions successful in conceiving, implementing and sustaining reform have addressed. We propose that these are questions that all of us need to be asking about our work and present them here for your consideration.

Sincerely,

Jeanne L. Narum

Jeanne L. Narum, Director
Project Kaleidoscope

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❖ Vision

But an institution cannot be built of wholesome usage, until its precise mission has been determined. An institution is a machine in that its whole structure and functioning must be divined in view of the service it is expected to perform. Any alteration, or touching up, or adjustment about this house of ours, unless it starts by reviewing the problem of its mission— clearly, decisively, truthfully— will be love's labors lost.

— José Ortega y Gasset
Mission of the University

A vision statement for the sciences and mathematics on a campus is critical to successful reform.

Questions:

Is there a current formal vision statement that:

- focuses on student learning
- reflects consensus of the campus community, including senior administrators and faculty, trustees
- reflects consensus of individual SME&T departments and programs
- reflects the institutional identity and mission
- responds to the changing world of science and technology
- responds to new understandings about how students learn
- responds to concerns about integrating research and education
- reflects careful thinking about the purpose of education in a changing world?

Does it outline areas in which the institution can achieve distinction?

❖

Within the last two years, we've launched a major comprehensive planning initiative to address the needs of the campus's science and mathematical sciences departments. In focusing on matters involving the curriculum, facilities, and new teaching strategies, this is what we considered:

- *As science becomes more important to our daily lives, a pedagogical and philosophical shift has occurred, toward the idea of a "natural science community" in which* all *students can get involved in science, even "non-science" students. The liberal arts mission has always been to teach students to think critically, and acquiring transferable skills of scientific inquiry is integral to this process. Science has to be accessible and available to all students. This has applications not only for curriculum and course design, but also for the physical design of science buildings.*

The future of liberal arts education is inextricably linked to the teaching of the sciences. Our Science Initiative is a giant step forward into this future.

— Excerpt, Alumni Magazine

Agenda for Action ❖

Building from the vision statement, an agenda for action that outlines academic and financial objectives (for a five- and ten-year period) to achieve goals is vital.

Questions:
Is an agenda in place that identifies:

- anticipated curricular changes
- anticipated facilities modernization needs
- resources needed at each stage of reform, outlining ways to secure/reallocate essential time and dollars (and people)
- means to evaluate and assess reforms as they are developed and implemented
- ways to link the plan to institutional procedures for governance, budgeting, fund-raising?

Does the agenda include tactics to keep the community informed about and appropriately involved in reform efforts?

❖

[We] were impressed by several themes that emerged from these sessions:

1. *The process of planning, designing, and constructing a building is a long and arduous task, often requiring several years for completion.*
2. *The process of designing a new building should always begin with program planning: deciding what the building is to accomplish. Consideration must be given to curriculum, pedagogy, and programs that will take place in the building.*
3. *There must be a vision for the building. What will this building allow the university to do that it is not currently doing?*
4. *The project must be fully enrolled by all important parties. Input at all stages from all parties—designers, faculty, staff, students administrators, and regents—is essential.*

— Report, PKAL Seminar on Facilities Planning

The evidence...is clear - the improvements achieved have not been widely implemented and are not sustainable without significant change in the culture, policies, and practices of higher education. It is not enough that individual faculty members in isolated ways advance student learning. Many...have suggested that what we need is not *more innovation* but *more implementation*, so that local improvements are both spread throughout the institution and made sustainable over time. Otherwise, gains will be transitory and depend on the comings and goings of individual faculty and administrators.

— NSF. *Shaping the Future.*

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❖ Institutional Portfolio

When we talk about revitalizing a society or an organization we tend to put exclusive emphasis on finding new ideas. But there is usually no shortage of new ideas; the problem is to get a hearing for them. And that means breaking through the crusty rigidity and stubborn complacency of the *status quo*. The aging society or organization has developed defenses against new ideas--"mind-forged manacles," in William Blake's vivid phrase.

— John Gardner. *Self-renewal.*

Preparing an institutional 'portfolio' is one means to gather the materials that ground your dreaming and planning in reality— base-line information to document the impact of your reforms on students, faculty, programs, budgets and campus culture.

Questions:

In regard to students, is information readily available on their:

- background, level of preparation, career aspirations
- achievements and persistence in SME&T courses
- attitudes about science/mathematics
- achievements as alumni?

Have departments and programs:

- set explicit learning goals
- monitored patterns of enrollments and student achievements
- measured the impact of new pedagogies and new curricula?

From the perspective of faculty, have discussions taken place about:

- anticipated retirements, new position openings
- current expertise and experience available to implement agenda for action?

Finally, has attention been given to reviewing organizational policies and structures essential for building and sustaining a strong undergraduate SME&T program? Are the right ones in place? What is the evidence?

❖

- *Are [there] well crafted mechanisms of communication that keep the right people in the loop at the right time about the communal effort to reform, within and between departments, across the campus? What are they?*
- *How visible is the commitment and support (buy-in) of senior administrators? How is this commitment translated into action?*
- *Has time been taken—as a community—to think through the risks of making changes, as well as the risks of maintaining the* status quo*?*

— Excerpt, Keck/PKAL Consultant Papers

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There is a certain kind of learning that works.

Questions:
Is evidence readily available, by program/department, that attention has been given to what works for their students, at this time? What evidence is there that faculty and administrators have pursued:

- revitaiizing introductory courses, for science majors, and for students majoring in other fields
- assuring all students have opportunity for a rigorous (and fun) encounter with programs that work in mathematics and the sciences
- incorporating effective new technologies and pedagogical approaches into class and lab at all levels
- establishing interdisciplinary teaching and programs
- encouraging faculty interaction across the diseiplines
- encouraging faculty to integrate their scholarship and their teaching
- incorporating new scientific understandings, with addressing the 'less is more' issue
- exploring new departmental structures and sequences
- addressing changing societal needs (K-12 teachers, workforce, etc.)
- connecting reforms to larger institutional vision and planning?

Is your institutional vision one of building natural sciences communities?

❖

The course is built around an overall theme mostly designed by the students as they pose questions related to the theme. Their questions lead to experiments that they design themselves, and then they submit a proposal with equipment needs. The next class period, they perform the experiments, and interpret the results with guidance from the instructors. As they participate in the self-designed activities, students rediscover the fun of science, while at the same time they learn to think and analyze critically, broadening their scientific and mathematical backgrounds, and appreciating the interrelationships that exist between mathematics and all of the scientific disciplines. Another interesting feature of this course, is the use of "Peer Mentors," advanced undergraduate students who help the students design their experiments, refine their questions, and generally facilitate the classroom activities. In the process, those students will learn more about science and the joys of teaching science.

— Reports, PKAL Faculty for the 21st Century Members

Moore has described science as a "way of knowing," specifically a method that involves disciplined inquiry in the creation of new knowledge. Inquiry— the natural way in which scientists create new knowledge, present it for peer review, and try it out on new settings— can provide a model for how college teaching can likewise become an active process. Scientists and engineers ask questions, and they search for answers by gathering, collating, and interpreting data, weighing risks and benefits, sharing proposed explanations and solutions, and then trying these new proposals out in different contexts. This may raise new questions, and so the process continues in cyclic fashion. Science teaching is often most effective when it captures methods of thinking that scientists use when exploring the world. Successful learning is a complex process that involves more than manipulating symbols or numbers and executing instructions in the laboratory. The activity of finding out can be as important as knowing the answer.

— NRC. *Science Teaching Reconsidered.*

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❖ Resources

Lack of adequate resources assures inadequate attention to long-term curriculum renewal, constricts the number of faculty engaged regularly in broad-based instructional scholarship, and sustains an unfortunate and inaccurate impression in the minds of many that teaching well is unimportant and without merit. The current condition of the American educational infrastructure should not be viewed as a problem to be fixed by a few, focused, temporary initiatives. All parties— education, industry, State and Federal agencies, and the public— must recognize that regularly budgeted, long-term programs for curriculum renewal to maintain the faculty's instructional excellence are as essential as funds for disciplinary renewal to maintain their technical currency.

— NSF. *America's Academic Future.*

Resources need to be found, through reallocating existing budgets and/or securing significant gifts and grants, to provide incentives and support for the work of reform.

Questions:

What evidence is there that attention is given to:

- **human resources:** Are the right people (with the right experience and expertise) in place within departments and administrative offices (including grants officers) and in supporting positions to achieve aims and objectives of the strategic plan, over a five/ten year period, and are consultants available as needed?
- **physical resources:** Do spaces accommodate new approaches to learning and teaching, new technologies, and--most important--do they support the natural science community on your campus?
- **fiscal resources:** Do operating and capital budgets, built on income from tuition and fees and from gifts and grants, anticipate and support the building and sustaining of the human and physical infrastructure needed?

In addition, have resources been allocated and reallocated, at the departmental and institutional level, in ways that explicitly target goals in the institutional vision statement? Are resources available to support faculty as they develop new approaches to teaching and research, and to experiment with change in what is to be taught and how it is to be taught?

❖

We are also pleased to see that you will move to add line items for undergraduate research and student travel to departmental budgets. A base of funding for these activities from college sources is critical. To reach the level of undergraduate research activity to which we believe you rightly aspire, there will also have to be a significant increase in outside support.

New faculty in the science environment you envisage for your institutions will indeed require start-up funds. We are pleased to see you planning for this in the context of planning to renovate student/faculty research space.

— Recommendations, Keck/PKAL Consultancy

♦ *Hampshire College* ♦ *Hanover College* ♦ *Hartwick College* ♦ *Harvey Mudd College* ♦ *Haverford College* ♦ *Hawkeye Community College* ♦ *Hazard Community College* ♦ *Heidelberg College* ♦ *Hendrix College* ♦ *Hiram College* ♦ *Hobart and William Smith Colleges* ♦ *Hollins College* ♦ *Hood College* ♦ *Hope College* ♦ *Howard University* ♦ *Huntington College* ♦ *Illinois College* ♦ *Illinois Wesleyan University* ♦ *Indiana State University* ♦ *Indiana University at Bloomington* ♦ *Indiana University of Pennsylvania* ♦ *Indiana University-Purdue Univ. at Indianapolis* ♦ *Iona College* ♦ *Jacksonville University* ♦ *James Madison University* ♦ *John Carroll University* ♦ *John Wood Community College* ♦ *Johnson C. Smith University* ♦ *Joliet Junior College* ♦ *Judson College* ♦ *Juniata College* ♦ *Kalamazoo College* ♦ *Kalamazoo Valley Community College* ♦ *Kansas State University* ♦ *Keene State College* ♦ *Kennesaw State University* ♦ *Kenyon College* ♦ *Keuka College* ♦ *Keystone College* ♦ *King*

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Ultimately, the success of our work depends on the support of many people. It depends on our colleagues on our own campuses, in our own departments and programs. Yet it also depends on the support of non-scientists— administrators and faculty in other disciplines, the local and national community, citizens and legislators. Thus, in addition to keeping internal avenues of communication open, faculty and their administrative colleagues have a vital obligation to inform the broader external community of what they do, and why it is so important.

Questions:

What evidence is there that faculty, administrators and students are visible and vocal advocates on and beyond the campus for the work of transforming the environment for learning for undergraduate students in science and mathematics? What is the level of:

- student involvement in national undergraduate research organizations
- faculty leadership in regional and national disciplinary and professional associations focusing on education
- faculty and administrative advocacy for support for a strong undergraduate community, locally, and in an the state and federal arena
- collaborative efforts with local and regional K-12 schools, with neighboring industry, with other higher educational institutions?

❖

I am passionate about learning and I want my students to share this passion—I want them to experience the joy of scientific discovery. But, the escalating cost of scientific education has become a very serious issue. Effective science education not only requires continual purchasing and replacement of expensive equipment; it also requires modern facilities and low student/teacher ratios. As a result, many institutions have become reluctant to commit adequate resources to science. If we are to reverse this trend, we must become more effective at communicating the importance and relevance of the sciences, both to the public and to our non-science faculty, colleagues, and administrators. We must make it our business to be <u>clear</u>—clear about what we do, why we are so passionate about what we do, and why what we do is worth every penny.

— Statement, PKAL Faculty for the 21st Century Member

There is a crying need for thousands of scientists to participate locally in public outreach and advocacy activities that will reinforce every community's commitment to the production of public goods— ...another way of describing the work of science. There are many ways for a scientist to become involved...through visits to schools or guest lectures at civic clubs, churches, and senior centers, for example. Ultimately, every scientist should be able to answer "yes" to what I call the "7-11 test": do your community leaders recognize you by sight and know your issues when you see each other in the local convenience store? Does the editor of the local newspaper, the producer of local television news, a city council member, and your member of Congress know you? ...[H]ave you explained to these community leaders what science is contributing to their community in terms of good jobs and as a source of civic pride, in terms of returning federal dollars to their congressional district, and in terms of how the scientific work you do is important to their quality of life and that of their children and grandchildren?

— Mary Wooley, *Science*

College ◆ King's College ◆ Knox College ◆ Kutztown University ◆ La Salle University ◆ La Sierra University ◆ Lafayette College ◆ Lake Forest College ◆ La... Superior State University ◆ Lander University ◆ Lane College ◆ Lawrence University ◆ Lees College ◆ Lehigh University ◆ Lenoir-Rhyne College ◆ Lewis and Clark College ◆ Lexington Community College ◆ Lima Technical College ◆ Lincoln University (MO) ◆ Lindsey Wilson College ◆ Linn-Benton Community College ◆ Livingstone College ◆ Longview Community College ◆ Louisiana State University at Shreveport ◆ Loyola College-Maryland ◆ Loyola Marymount University ◆ Loyola University ◆ Luther College ◆ Lynchburg College ◆ Lyon College ◆ MacMurray College ◆ Macalester College ◆ Madison Area Technical College ◆ Malone College ◆ Manchester College ◆ Marian College (WI) ◆ Marietta College ◆ Marist College ◆ Mars Hill College ◆ Martin Luther College ◆ Mary Washington College ◆ Maryville College

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❖ The Question of Reform

...[T]he purpose of education, as opposed to information, is to lead us to some sense of citizenship, to some shared assumptions about individual freedoms and institutional needs, to some sense of the full claims of self as they are to be shared with others. For some, I may have a much too old-fashioned sense of the civic claims of education and an insufficient regard for the social claims. But I would argue that without an ethically based civic sense, nourished in an individual through education, larger social claims issue merely into programs for action with no controlling perspective about what the action is for. Action without a deeper purpose is useless; it is only activity, and that is always finally susceptible to the sweet, solipsistic allure of anarchy. Historically, education has been the best stay against such confusion, by fostering the civilizing ability to make choices and to act responsibly for others on the basis of those choices.

— A. Bartlett Giamatti, *A Free and Ordered Space*.

The question of reform is how to transform the environment for learning so that undergraduate students are prepared "...to make choices and to act responsibly for others on the basis of those choices" in the "...kind of century that is just around the corner..." in the memorable words of Lewis Thomas. Thus, for faculty and their administrative colleagues, in the work of reform, another question is *to whom will it make a difference?* To your students, in your own work in classroom and lab, to the K-12 or the disciplinary communities, to society?

Questions:

Is data being gathered in a conscientious and useful way to answer the question *to whom will it make a difference?* Do you know how new and reshaped courses and programs are serving:

- departmental & science/mathematics majors preparing for careers in the scientific and technological community
- students preparing for careers as K-12 teachers
- students who as citizens will be called to deal with public policy issues in a world in which science and technology have an increasing impact on all areas of life and work.

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This type of original research turns people on to the sciences. Even as an undergraduate, you can think you are contributing to the scientific community. Gaining that sense of community and collegiality with other scientists gave me a sense of identity. I have begun to feel like a scientist.

— Report, Student Involved in PKAL *Programs that Work*

♦ *McHenry County College* ♦ *McMurry University* ♦ *McPherson College* ♦ *Meredith College* ♦ *Mesa Community College* ♦ *Miami University* ♦ *Middle Tennessee State University* ♦ *Middlebury College* ♦ *Midland Lutheran College* ♦ *Miles College* ♦ *Milliken University* ♦ *Mills College* ♦ *Millsaps College* ♦ *Milwaukee School of Engineering* ♦ *Mississippi State University* ♦ *Mississippi Valley State University* ♦ *Missouri Western State College* ♦ *MoJesto Junior College* ♦ *Monmouth College* ♦ *Monmouth University* ♦ *Montana State University* ♦ *Montana Tech of the University of Montana* ♦ *Montclair State University* ♦ *Moorhead State University* ♦ *Moravian College* ♦ *Morehouse College* ♦ *Morgan State University* ♦ *Morningside College* ♦ *Morris Brown College* ♦ *Morris College* ♦ *Mount Holyoke College* ♦ *Mount Mary College* ♦ *Mount Saint Mary's College (CA)* ♦ *Mount Saint Mary's College and Seminary* ♦ *Mount Senario College* ♦ *Mount Union College* ♦ *Mount Vernon Nazarene*

❖

Colleges and universities have been presented with a unique opportunity to remake undergraduate education in science, mathematics, engineering, and technology. The reassessment of national goals set in motion by the end of the Cold War, the demographic changes occurring in the country, the financial constraints affecting many institutions and the rapidly growing influence of new technologies have contributed to an environment in which fundamental principles are being reexamined. The reexamination will inevitably change higher education. Toward what end depends on the decisions that colleges and universities make today and on the support they get to carry out those decisions in the future.

— National Research Council. *From Analysis to Action.*

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❖ About PKAL

PKAL Events—1996-1997:

- **15 PKAL workshops and seminars were held.**
- **Over 320 teams from institutions across the country participated in one or more PKAL workshop.**
- **850 faculty members and administrators attended a PKAL workshop/seminar; over 300 participants attended the 1996 F21 National Assembly.**
- **PKAL *Volume I: What Works: Building Natural Science Communities*, originally published in 1991, was reissued for distribution.**
- **The PKAL National Issues Task Force was established to make more explicit and visible to connections between a strong undergraduate SME&T community and the public interest.**
- **PKAL collaborates with the Chautauqua Institution, to sponsor a week celebrating *Science Education and the Spirit of Invention*, to be held July 28 - August 1.**

PKAL began in 1989, with support from the NSF, asking ourselves *as scientists we enjoy doing science; how can we get our students to enjoy doing science, from the very first day?* We answered that question by reflecting on what works in the environments with which we were most familiar at that time, the liberal arts colleges. Indeed, PKAL's first report was directed primarily at the liberal arts college community, and the first participants in PKAL were primarily from that educational sector.

However, the climate for change is quite different now. Colleges and universities in all parts of the country, of all sizes, public and private, have begun to pursue reform. One evidence of this is illustrated by the institutional listing at the bottom of these pages, showing the involvement in PKAL of all sectors of the undergraduate community. Our persisting focus on facilities planning and emerging concern about faculty careers—issues critical to two- and four-year colleges, comprehensive and research universities alike, is one reason for this growing diversity within PKAL.

In the coming year, the series of disciplinary and topical workshops and seminars will continue, as will our efforts to place material from these events on the PKAL Web Site, so that the discussions continue beyond a single event. The *Supplement to Volume III* will be available fall of 1997. The PKAL Faculty for the 21st Century Network will continue to grow, and we invite you to help us provide a wide range of leadership opportunities for these faculty members with demonstrated promise.

Finally, a word of thanks to so many. PKAL is basically a voluntary association of people who want to make a difference. Some of these are listed on the following pages— those who served on committees and those who took the time to spend a weekend as a workshop/seminar leader, those who serve as mentors for the F21 members. But there are more: the deans of F21 members who take seriously their commitment to young faculty; design professionals who respond to requests for photos and floor plans; administrators on host campuses who meet with workshop participants; and staff of NSF, Exxon Education Foundation, W.M. Keck Foundation, The Camille and Henry Dreyfus Foundation, Inc., who provide the tangible and intangible support that are both so critical to the work of PKAL.

This was a good year. We look forward to seeing you in 1997-98 and to work together in wrestling with the questions of reform.

Erie-Behrend ♦ Pepperdine University ♦ Philander Smith College ♦ Phillips Exeter Academy ♦ Pomona College ♦ Portland Community College ♦ Prescott College ♦ Princeton University ♦ Principia College ♦ Purdue University ♦ Purdue University North Central Campus ♦ Purdue University--Calumet ♦ Radford University ♦ Ramapo College of New Jersey ♦ Randolph-Macon College ♦ Rappahannock Community College ♦ Raritan Valley Community College ♦ Reed College ♦ Regis College ♦ Regis University ♦ Rensselaer Polytechnic Institute ♦ Rice University ♦ Richard Stockton College of New Jersey ♦ Ripon College ♦ Rochester Institute of Technology ♦ Rockford College ♦ Rockhurst College ♦ Roosevelt University ♦ Rowan College of New Jersey ♦ Rust College ♦ SUNY - Albany ♦ SUNY - New Paltz ♦ SUNY-College at Buffalo ♦ SUNY-College at Fredonia ♦ SUNY-Farmingdale ♦ Saint Anselm College ♦ Saint Francis College (PA) ♦ Saint Joseph College ♦ Saint Joseph's College

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Facilities:

Since 1992, PKAL has sponsored 13 seminars on facilities planning, and nearly 300 colleges and universities from all parts of the country have participated. With almost $2 billion in projects anticipated by this group, PKAL is developing a significant archive on how different institutions move to shape and reshape spaces to accommodate new pedagogical approaches and technologies, and provide an engaging, safe, efficient environment for the natural science community on their campuses.

The main publication in PKAL Phase II was *Structures for Science: A Handbook on Planning Facilities for Undergraduate Natural Science Communities*. Since early 1996, over 850 copies of the Handbook have been distributed. It incorporates materials from facilities seminars and Keck/PKAL consultant reports, presenting many of the questions that need to be addressed about the purpose and design of spaces.

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Faculty:

With support from the Exxon Education Foundation, PKAL has established a network specifically for SME&T faculty who, at an early career stage, are emerging as leaders within their local community and are recognized as having the potential for national leadership into the next century.

Members of the PKAL *Faculty for the 21st Century* (F21) are nominated by their academic dean, who makes a commitment to join with PKAL in providing significant opportunities for F21 members to become creative and productive *agents of change*. Such opportunities enable F21 members to:

- make **connections** with the current generation of leaders within the SME&T community, who serve as PKAL mentors
- engage in productive **dialogue** on critical issues that will be facing academic leaders into the 21st century
- assist in **planning**, **implementing**, and **evaluating efforts** to transform the learning environment for students in science, mathematics, engineering, and technology--locally and nationally.

The *Supplement to Volume III*, to be published in late 1997, will focus on recently-completed or in-progress projects that address, in a most creative and exemplary manner, the issues that colleges and universities face in planning new spaces.

The *Supplement* will also contain the report of the PKAL Committee of Visitors (COV). This COV, charged with determining the impact of improved facilities on student learning, faculty productivity, and institutional culture and budgets, is funded by a grant from the Office of Science and Technology Infrastructure at the National Science Foundation.

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Nearly 500 members of the PKAL F21 Classes of '94, '95, and '96, along with the newly inducted Class of '97, will be joined by their deans for the 1997 F21 National Assembly in Houston, TX. F21 members have been invited by NASA to spend a day at the Johnson Space Center to experience their work from the inside.

♦ *Saint Joseph's University (PA)* ♦ *Saint Mary's University of Minnesota* ♦ *Saint Mary-of-the-Woods College* ♦ *Saint Norbert College* ♦ *Saint Paul's College* ♦ *Salem-Teikyo University* ♦ *Salisbury State University* ♦ *Salish Kootenai College* ♦ *San Diego Community College District* ♦ *San Diego Miramar College* ♦ *San Diego State University* ♦ *Santa Clara University* ♦ *Seattle University* ♦ *Seton Hill College* ♦ *Shaw University* ♦ *Shepherd College* ♦ *Siena College* ♦ *Silver Lake College* ♦ *Skidmore College* ♦ *Snow College* ♦ *South Carolina State University* ♦ *South Dakota State University* ♦ *Southeast Missouri State University* ♦ *Southeastern Louisiana University* ♦ *Southern Illinois University at Edwardsville* ♦ *Southern Methodist University* ♦ *Southern Oregon State College* ♦ *Southern University at New Orleans* ♦ *Southwest Baptist University* ♦ *Southwest State University* ♦ *Southwestern College* ♦ *Southwestern University* ♦ *Spelman College* ♦ *Spring Arbor College* ♦ *St*

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Workshops and Seminars, 1996-97:

- **Planning Facilities for Undergraduate Science and Mathematics**– Atlanta, GA
- **Innovations in Earth and Planetary Science**– Franklin and Marshall College
- **Revitalizing Introductory Chemistry**– Columbia University
- **Science for All Students**– Skidmore College
- **The Research-Rich Environment**– Hope College
- **Mathematics and Computer Science**– University of Iowa
- **Science for all Students**– St. John's College-Santa Fe
- **Focusing on Diversity in Science and Mathematics**– Fort Lewis College
- **Planning Facilities for Undergraduate Science and Mathematics**– Duke University
- **Interdisciplinary Approaches to Teaching Science and Mathematics**– Colby College
- **Revitalizing Undergraduate Biology**– Morehouse College
- **Revitalizing Introductory Physics**–Louisiana State University
- **Facilities for Undergraduate Science and Mathematics**– The Salk Institute
- **The Future of Mathematics in Undergraduate Education**– Saint Mary's College of California

Supported by the Division of Undergraduate Education in the Directorate for Education and Human Resources at the National Science Foundation.

PKAL Workshops and Seminars:

PKAL workshops and seminars are designed to build connections and networks for the sharing of ideas and materials. Leaders, all reflective practitioners in the field of educational reform, bring significant experience and expertise to the sessions. They are a rich resource for responding to specific questions from individual teams, and their presentations collectively present a diverse set of models to adapt. Workshop evaluations ask for *'the best idea I am taking home is...'* From those responses and follow-up reports, we learn that ideas can be transplanted.

Best Ideas:

From the 1996-97 workshops, some best ideas are:

- *The importance of making research visible on campus, through symposia, posters, publicity in campus and regional media, etc.*
  — The Research-rich Environment, Hope College
- *A much greater awareness of how learning works from the student's perspective, including an appreciation of the importance of dealing with existing misconceptions before trying to teach new material*
  — Innovations in Earth and Planetary Science, Franklin and Marshall College
- *Strategies to incorporate more of the scientific process (active learning) into gen chem and organic, and how to retool several of our existing experiments in the introductory course by introducing topics that students can relate to from everyday experience*
  — Revitalizing Introductory Chemistry, Columbia University
- *That impediments to reform are almost universal, and that I have to rethink my approach and seek into about overcoming resistance*
  — Revitalizing Introductory Biology, Morehouse College
- *The importance of continuing our efforts focusing on 'less is more' and how to add group problem-solving exercises within the lecture*
  — Revitalizing Introductory Physics, Louisiana State University
- *Ways to incorporate the 'science for all students' approach into our new integrated core (natural and social science, humanities), and how to work with colleagues across the campus in developing this core*
  — Science for All Students, Skidmore College
- *That there are many faculty eager to talk about their teaching, and how to get my colleagues to share their ideas*
  — Mathematics and Computer Science, University of Iowa

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PKAL on the Internet:

Project Kaleidoscope's enhanced web site models our kaleidoscopic approach to the reform of undergraduate SME&T education, focusing on faculty and facilities, curricular, institutional and national issues. This site provides access to valuable resources on *what works* in undergraduate SME&T education, as well as an opportunity for those committed to reform to stay connected through discussion boards and email. Here you will find:

Information on PKAL:

- *PKAL Events:* Application Procedures, Presentations, Current News
- *What Works in PKAL Workshops:* Best Ideas and Agendas for Action
- *PKAL Faculty for the 21st Century Network:* Member Pages and Activities
- *Leaders in SME&T Reform:* Biographies and Statements

The Commons:

A forum for the discussion of critical issues and questions about transforming the undergraduate SME&T environment. This is a place to voice your opinions, pose questions, and learn from colleagues across the web.

Alerts and Resources:

A listing of information on national events, position openings, and educational resources of interest to the undergraduate SME&T community.

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Keck/PKAL Consultant Program:

With support from the W.M. Keck Foundation, PKAL offers the services of consultants to institutions that have sent teams to PKAL workshops and seminars, and/or are involved with the PKAL F21 Network. The Keck/PKAL Consultants arrive on a campus after a careful institutional self-analysis of the current status of reform, based on ideas emerging from PKAL participation. The keys to a successful Keck/PKAL consultancy are the level of involvement of senior administrators, the willingness of faculty— as individuals and departments— to consider hard questions, and the commitment of the community to act on recommendations made. Since 1993-94, sixty-seven colleges and universities have been involved with the Keck/PKAL Consultant Program.

PKAL's Web Site:

http://www.pkal.org

Event Announcements and Postings:
To add your resource to the PKAL Web Site, submit your 10-20 word announcements, indicating where further information can be found, to the PKAL National Office.

PKAL Email:
To stay connected with PKAL, receiving information on PKAL programs, and workshop announcements and updates, send a message to the PKAL National Office at:

icopkal@mindspring.com

The development of the Chemistry pages on the PKAL Web Site is supported in part by The Camille and Henry Dreyfus Foundation, Inc.

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Did you ever see a crystal grow? In my physics classes, I sometimes showed an interesting demonstration. I put a certain substance, heated to a temperature just above its melting point, into a glass container with flat sides and placed it between plates of polaroid. I then shone light through it and projected a pattern on the screen. What was visible was chaos, irregularly streaming bits of liquid, random motion. The phenomenon was interesting in its caprice, in the completely unpredictable nature of its detail.

Then suddenly as the liquid cooled below its melting point, crystallization began. At a certain point within the molten mass, where chance decreed that it should happen, a little regular edge would form and become the seed of a pattern of regularity and beauty. One crystalline facet was added to another, and a strange kaleidoscopic design penetrate what was previously a volume filled with chaos. The penetration was erratic, proceeding sometimes along a narrow channel, sometimes in a broad expanse. But wherever it went, the material interior to the crystallized domain was resplendent with colorful order and geometric beauty: symmetry, harmony, and predictability were present everywhere.

— Henry Margenau. *The New Faith of Science*

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